

suitability guidelines established by DOE. DOE is also subject to environmental protection and transportation requirements such as those set by the Clean Air Act; Clean Water Act; Hazardous Material Transportation Act; Emergency Planning and Community Right-to-Know Act of 1986; Comprehensive Environmental Response, Compensation, and Liability Act; Resource Conservation and Recovery Act; National Historic Preservation Act; Archaeological Resources Protection Act; Endangered Species Act; Nuclear Regulatory Commission regulations applicable to the transportation of radioactive materials; U.S. Department of Transportation regulations governing the transportation of hazardous materials; and applicable Nevada State statutes and regulations. In accordance with several statutes, DOE would need several new permits, licenses, and approvals from both Federal and State agencies to construct, operate and monitor, and eventually close the proposed Yucca Mountain Repository.

Under the authority of the Atomic Energy Act, DOE is responsible for establishing a comprehensive health, safety, and environmental program for its activities and facilities. The Department has established a framework for managing its facilities through the promulgation of regulations and the issuance of DOE Orders. In general, DOE Orders set forth policies, programs, and procedures for implementing policies. Many DOE Orders contain specific requirements in the areas of radiation protection, nuclear safety and safeguards, and security of nuclear material. Because the Nuclear Regulatory Commission is authorized to license the proposed Yucca Mountain repository, DOE issued Order 250.1 exempting such a repository from compliance with provisions of DOE Orders that overlap or duplicate Nuclear Regulatory Commission licensing requirements.

DOE has interacted with agencies authorized to issue permits, licenses, and other regulatory approvals, as well as those responsible for protecting such significant resources as endangered species, wetlands, or historic properties. DOE also has coordinated with the affected units of local government, U.S. Nuclear Regulatory Commission, U.S. Air Force, U.S. Navy, U.S. Department of Agriculture, U.S. Department of Transportation, U.S. Environmental Protection Agency, Department of the Interior including its Bureaus (U.S. Fish and Wildlife Service, National Park Service, and Bureau of Land Management), the Council on Environmental Quality, Nevada Department of Transportation, and Native American tribes. In addition, DOE provided a copy of the Draft EIS and Supplement to the Draft EIS to these agencies and entities.

S.12 Conclusions

S.12.1 MAJOR CONCLUSIONS OF THE EIS

In general, the Proposed Action would cause small, short-term public health impacts due primarily to the transportation of spent nuclear fuel and high-level radioactive waste from the existing commercial and DOE sites to the proposed repository. The specific impacts at the repository site would be very small as indicated in Table S-1. The transportation impacts would be associated mainly with nonradiological traffic fatalities and very low radiological doses to members of the public from the routine transportation of radioactive materials.

The EIS analysis demonstrated that the long-term performance of the proposed repository over 10,000 years would result in a mean peak annual dose of 0.00002 millirem to a reasonably maximally exposed individual hypothetically located 18 kilometers (11 miles) from the repository. The analysis of a human intrusion event occurring at 30,000 years indicated a mean peak annual dose of 0.002 millirem to the reasonably maximally exposed individual at the same location.

As a result of this evaluation, DOE does not expect the repository to result in impacts to public health beyond those that could result from the prescribed radiation exposure and activity concentration limits in 40 CFR Part 197 and 10 CFR Part 63 during the 10,000-year period after closure.

IMPACTS FROM THE PROPOSED ACTION

Nonradiological hazards

- 2 to 3 worker fatalities from repository construction, operation and monitoring, and closure
- 2 to 4 worker fatalities from traffic accidents while commuting to and from the repository
- 6 to 14 traffic fatalities associated with the transportation of construction materials and public involved in accidents with commuters
- 3 to 5 traffic fatalities associated with the shipment of spent nuclear fuel and high-level radioactive waste
- 2 to 3 fatalities in the general population due to latent effects of vehicle emissions (transportation of spent nuclear fuel and high-level radioactive waste, construction materials, and commuters)

Radiological

- 4 to 7 latent cancer fatalities to workers at the repository
- 3 to 12 latent cancer fatalities to workers during the loading and transport of spent nuclear fuel and high-level radioactive waste
- 0.5 to 2 latent cancer fatalities in the general population from releases of naturally occurring radon from the repository
- 0.6 to 2.5 latent cancer fatalities in the general population from loading and transport of spent nuclear fuel and high-level radioactive waste
- Essentially zero long-term latent cancer fatalities within 10,000 years associated with the repository performance

These values represent the range of impacts for all operating modes, transportation scenarios, and implementing alternatives.

Under the No-Action Alternative, latent cancer fatalities would be unlikely in the short term in either the worker or public populations. These short-term impacts would be very similar to those associated with the Proposed Action. In addition, under the No-Action Alternative there would be no impacts associated with the transportation of spent nuclear fuel and high-level radioactive waste to the proposed repository. However, the obligation to store these materials continually in a safe configuration would become the responsibility of future generations.

There could be large public health and environmental consequences under the No-Action Alternative if there were no effective institutional control, causing storage facilities and containers to deteriorate and radioactive contaminants from the spent nuclear fuel and high-level radioactive waste to enter the environment. In such circumstances, there would be widespread contamination at the 72 commercial and 5 DOE sites across the United States, with resulting human health impacts.

Table S-1 compares the potential impacts associated with the Proposed Action to those associated with the No-Action Alternative.

S.12.2 DISTINCTIONS BETWEEN IMPACTS OF THE PROPOSED ACTION AND NO-ACTION ALTERNATIVE

The analysis of the potential short-term environmental impacts associated with the Proposed Action and with the two No-Action scenarios revealed that the impacts would be small and related to health and safety and to socioeconomics.

Table S-1. Impacts associated with the Proposed Action and No-Action Alternative.^a (page 1 of 4).

Resource area	Flexible design potential operating modes—range of impacts			No-Action Alternative		
	Short-term (through closure)		Long-term (after closure, to 10,000 years)	Short-term (100 years)	Long-term (100 to 10,000 years)	
	Repository	Transportation			Scenario 1	Scenario 2
<i>Land use and ownership</i>	Small; the flexible design range of disturbed land is from 4.3 km ^{2(b)} to about 6.0 km ² of the 600 km ² that comprise the analyzed withdrawal area	Small to moderate; 0 to about 20 km ² of land disturbed for new transportation routes; Air Force identified Nellis Air Force Range conflicts for some routes; some routes pass close to or through Wilderness Study Areas; some corridors could directly impact Native Americans and Indian reservations; and one corridor could conflict with the Ivanpah Airport construction and operation	Small; potential for limited access into the area; the only surface features remaining would be markers	Small; storage would continue at existing sites	Small; storage would continue at existing sites	Large; potential contamination of 0.04 to 0.4 km ² surrounding each of the 72 commercial and 5 DOE sites
<i>Air quality</i>	Small; releases and exposures well below regulatory limits (less than 6 percent of limits)	Small; releases and exposures below regulatory limits; pollutants from vehicle traffic and trains would be small in comparison to other national vehicle and train traffic; Clean Air Act General Conformity Requirements might apply in Clark County Nevada	Very small, 5.3×10^{-10} latent cancer fatalities peak effect	Small; releases and exposures well below regulatory limits	Small; releases and exposures well below regulatory limits	Small; degraded facilities would preclude large atmospheric releases
<i>Hydrology (groundwater and surface water)</i>	Groundwater—small; water demand (230 to 290 acre-feet ^c per year) well below lowest estimate of the groundwater basin's perennial yield (580 acre-feet)	Small; withdrawal of up to 710 acre-feet from multiple wells and hydrographic areas over about 4 years	Small amounts of contamination of groundwater in Amargosa Valley during the first 10,000 years. Contamination is several hundred thousand times less than the groundwater protection standard in 40 CFR 197	Small; usage would be small in comparison to other site use	Small; usage would be small in comparison to other site use	Large; potential for radiological contamination of groundwater around 72 commercial and 5 DOE sites
	Surface water—small; new land disturbance of 2.8 to 4.5 square kilometers would result in minor changes to runoff and infiltration rates; floodplain assessment concluded impacts would be small	Small; minor changes to runoff and infiltration rates; all rail corridors pass through areas of identified 100-year flood zones; additional floodplain assessments would be performed in the future as necessary	Small; minor changes to runoff and infiltration rates	Small; minor changes to runoff and infiltration rates	Small; minor changes to runoff and infiltration rates	Large; potential for radiological releases and contamination of drainage basins downstream of 72 commercial and 5 DOE sites (concentrations potentially exceeding current regulatory limits)

Table S-1. Impacts associated with the Proposed Action and No-Action Alternative.^a (page 2 of 4).

Resource area	Flexible design potential operating modes—range of impacts			No-Action Alternative		
	Short-term (through closure)		Long-term (after closure, to 10,000 years)	Short-term (100 years)	Long-term (100 to 10,000 years)	
	Repository	Transportation			Scenario 1	Scenario 2
<i>Biological resources and soils</i>	Small to moderate; loss of about 4.3 km ² to 6.0 km ² of desert soil, habitat, and vegetation; adverse impacts to individual threatened desert tortoises (not the species as a whole); reasonable and prudent measures to minimize impacts; impacts to other plants and animals and habitat small; wetlands assessment concluded impacts would be small	Small to moderate; loss of 0 to 20 km ² of desert soil, habitat, and vegetation for heavy-haul routes and rail corridors; adverse impacts to individual threatened desert tortoises (not the species as a whole); reasonable and prudent measures to minimize impacts; impacts to other plants and animals and habitat small; additional wetlands assessments would be performed in the future as necessary prior to any construction	Small; slight increase in temperature of surface soil directly over the repository for 10,000 years resulting in a potential temporary shift in plant and animal communities in this small area (about 8 km ²)	Small; storage would continue at existing sites	Small; storage would continue at existing sites	Large; potential adverse impacts at each of the 77 sites from subsurface contamination of 0.04 to 0.4 km ²
<i>Cultural resources</i>	Small to moderate; repository development would disturb up to about 4.5 km ² of previously undisturbed land; mitigation measures would avoid or minimize damage to and illicit collecting at archaeological sites; programs in place to minimize impacts; opposing Native American viewpoint	Small to moderate; loss of 0 to 20 km ² of land disturbed for new transportation routes; mitigation measures would avoid or minimize damage to and illicit collecting at archaeological sites; programs in place to minimize impacts; opposing Native American viewpoint	Small; potential for limited access into the area; opposing Native American viewpoint	Small; storage would continue at existing sites; limited potential of disturbing sites	Small; storage would continue at existing sites; limited potential of disturbing sites	Small; no construction or operation activities; no impacts
<i>Socioeconomics</i>	Small; estimated peak total employment of 3,400 occurring in 2006 would result in less than a 1 percent increase in composite regional employment; therefore, impacts would be small. Estimated peak direct employment for the repository during construction would be approximately 1,900 in 2006.	Small; employment increases would range from less than 1 percent to 4.9 percent (use of intermodal transfer station in Lincoln County) of employment in affected counties	Small; no workers, no impact	Small; population and employment changes would be small compared to totals in the regions	Small; population and employment changes would be small compared to totals in the regions	Small; no workers; no impacts
<i>Occupational and public health and safety</i>						
Public						
Radiological ^d						
MEI (probability of an LCF)	1.6×10 ⁻⁵ to 3.1×10 ⁻⁵	1.4×10 ⁻⁴ to 1.2×10 ⁻³	4×10 ⁻¹⁰ to 4×10 ⁻⁹ at the boundary of the controlled area (approximately 18 km south of the repository)	4.3×10 ⁻⁶	1.3×10 ⁻⁶	(e)
Population (LCFs)	0.46 to 2.0	0.61 to 2.5	2×10 ⁻⁶ to 3×10 ⁻⁴	0.41	3	3,300 ^f
Nonradiological (fatalities due to emissions)	Small; exposures well below regulatory limits	1.6 to 2.8 ^g	Small; exposures well below regulatory limits or guidelines	Small; exposures well below regulatory limits or guidelines	Small; exposures well below regulatory limits or guidelines	Moderate to large; substantial increases in releases of hazardous substances in the spent nuclear fuel and high-level radioactive waste and exposures to the public

Table S-1. Impacts associated with the Proposed Action and No-Action Alternative.^a (page 3 of 4).

Resource area	Flexible design potential operating modes—range of impacts			No-Action Alternative		
	Short-term (through closure)		Long-term (after closure, to 10,000 years)	Short-term	Long-term (100 to 10,000 years)	
	Repository	Transportation		(100 years)	Scenario 1	Scenario 2
<i>Occupational and public health and safety (continued)</i>						
Workers (involved and noninvolved)						
Radiological (LCFs)	4.0 to 6.8	3.2 to 11.7	No workers, no impacts	16	10	No workers, no impacts
Nonradiological fatalities (includes commuting traffic fatalities)	2.0 to 3.3	12 to 23 ^b	No workers, no impacts	9	1,080	No workers, no impacts
<i>Accidents</i>						
Public						
Radiological						
MEI (probability of an LCF)	2.9×10 ⁻¹³ to 1.9×10 ⁻⁵	0.0015 to 0.015	Not applicable	No impacts	No impacts	Not applicable
Population (LCFs)	1.4×10 ⁻¹¹ to 1.1×10 ⁻²	0.55 to 5	Not applicable	No impacts	No impacts	3 to 13
Workers	Large; for some unlikely accident scenarios workers would likely be severely injured or killed	Large; for some unlikely accident scenarios workers would likely be severely injured or killed	No workers, no impacts	Large; for some unlikely accident scenarios workers would likely be severely injured or killed	Large; for some unlikely accident scenarios workers would likely be severely injured or killed	Small; no workers; no impacts
<i>Noise/Ground Vibration</i>	Small; impacts to public would be low due to large distances to residences; workers exposed to elevated noise levels—controls and protection used as necessary	Small to moderate; transient and not excessive, less noise than 90 dBA ¹ ; ground vibration infrequent and less than 88 dBV at 25 m	Small; no activities, therefore, no noise or ground vibration	Small; transient and not excessive, less than 90 dBA	Small; transient and not excessive, less than 90 dBA	Small; no activities, therefore, no noise
<i>Aesthetics</i>	Small; low adverse impacts to aesthetic or visual resources in the area. There may be increase in lighting impacts due to lighting associated with the ventilation system	Small; possible temporary and transient; conflict with visual resource management goals for Wilson Pass Option of the Jean rail corridor; and discernible impacts from the Caliente Intermodal transfer facility near Kershaw-Ryan State Park.	Small; only surface features remaining would be markers	Small; storage would continue at existing sites; expansion as needed	Small; storage would continue at existing sites; expansion as needed	Small; aesthetic value decreases as facilities degrade
<i>Utilities, energy, materials, and site services</i>	Small; use of materials would be very small in comparison to amounts used in the region; electric power delivery system to the Yucca Mountain site would have to be enhanced	Small; use of materials and energy would be small in comparison to amounts used nationally	Small; no use of materials or energy	Small; materials and energy use would be small compared to total site use	Small; materials and energy use would be small compared to total site use	Small; no use of materials or energy
<i>Management of site-generated waste and hazardous materials</i>	Small; radioactive and hazardous waste generated would be a few percent of existing offsite capacity; other wastes would be managed onsite	Small; waste generated would be a fraction of existing offsite capacity	Small; no waste generated or hazardous materials used	Small; waste generated and materials used would be small compared to total site generation and use	Small; waste generated and materials used would be small compared to total site generation and use	Small; no waste generated or hazardous materials used

Table S-1. Impacts associated with the Proposed Action and No-Action Alternative.^a (page 4 of 4).

Resource area	Flexible design potential operating modes – range of impacts			No-Action Alternative		
	Short-term (through closure)		Long-term (after closure, to 10,000 years)	Short-term (100 years)	Long-term (100 to 10,000 years)	
	Repository	Transportation			Scenario 1	Scenario 2
<i>Environmental justice</i>	Small; no disproportionately high and adverse impacts to minority or low-income populations; opposing Native American viewpoint	Small; no disproportionately high and adverse impacts to minority or low-income populations; opposing Native American viewpoint	Small; no disproportionately high and adverse impacts to minority or low-income populations; opposing Native American viewpoint	Small; no disproportionately high and adverse impacts to minority or low-income populations	Small; no disproportionately high and adverse impacts to minority or low-income populations	Large; potential for disproportionately high and adverse impacts to minority or low-income populations

- a. Ranges might differ from simple addition of the minimum and maximum values listed for the constituent phases because these values might not correspond between different phases. For example, a scenario that maximizes impacts during construction could result in minimal impacts during operations.
- b. km² = square kilometers; to convert to acres, multiply by 247.1.
- c. To convert acre-feet to cubic meters, multiply by 1233.49.
- d. LCF = latent cancer fatality; MEI = maximally exposed individual.
- e. With no effective institutional controls, the maximally exposed individual could receive a fatal dose of radiation within a few weeks to months. Death would be caused by acute direct radiation exposure.
- f. Downstream exposed population of approximately 3.9 billion over 10,000 years.
- g. Nonradiological fatalities due to exhaust emissions health effects from spent nuclear fuel and high-level radioactive waste transportation, including loadout; exhaust emissions health effects from commuter and materials transportation for repository construction, operation, and closure; and rail line or heavy-haul truck/intermodal transfer station construction, maintenance, and operation.
- h. Nonradiological traffic fatalities from spent nuclear fuel and high-level radioactive waste transportation and commuter traffic fatalities. As many as 10 to 17 of these fatalities could be members of the public.
- i. dBA = *A-weighted decibels*, a common sound measurement. A-weighting accounts for the fact that the human ear responds more effectively to some pitches than to others. Higher pitches receive less weighting than lower ones.

For the Proposed Action, using DOE's preferred transportation mode (mostly rail), about 24 to 38 latent cancer fatalities and nonradiological fatalities would be associated with the transportation of spent nuclear fuel and high-level radioactive waste and the construction, operation and monitoring, and closure of the repository at Yucca Mountain. Depending on the transportation mode, transportation impacts of the Proposed Action would result in about 4 latent cancer fatalities and 14 to 23 nonradiological fatalities. Construction and operation of the repository would result in 4 to 8 latent cancer fatalities and 2 to 3 nonradiological fatalities, depending on the repository operating mode.

In comparison, there would be about 25 latent cancer fatalities and nonradiological fatalities from the No-Action Alternative (both scenarios) during the first 100 years. For both scenarios, there would be about 7 nonradiological fatalities from commuting and shipping construction materials and about 16 latent cancer fatalities and 2 nonradiological fatalities from construction and operations.

Short-term socioeconomic impacts would occur in the Yucca Mountain region and at the existing storage locations under the Proposed Action; impacts under the No-Action Alternative would occur only in the Yucca Mountain region. Under the Proposed Action, there would be nearly 2,700 new jobs in the three-county area around Yucca Mountain (Clark, Lincoln, and Nye Counties). In addition, under the Proposed Action there would be lost jobs at each of the sites across the United States as spent nuclear fuel and high-level radioactive waste was removed. Under the No-Action Alternative, there would be a loss of about 4,700 direct and indirect jobs in the three-county area around Yucca Mountain once reclamation was completed. There would be no short-term socioeconomic impacts at the storage sites under the No-Action Alternative.

The potential long-term (postclosure to 10,000 years) environmental impacts of the Proposed Action and No-Action Scenario 1 (continued institutional control) would also be small. Under the Proposed Action, there would be virtually no latent cancer fatalities (much less than 1) over 10,000 years. In addition, there would be a potential for very small impacts to vegetation and animals over the repository area as soil surface temperatures increased. Under the No-Action Scenario 1, there would be about 13 latent cancer fatalities and about 1,100 nonradiological fatalities associated with the construction and replacement of storage facilities, monitoring of facilities, worker commuting, and transportation of construction materials. Small impacts to other resources (for example, socioeconomics, biological resources, utilities and services) would occur.

There would be differences in the potential long-term environmental impacts under No-Action Scenario 2 (no institutional control after 100 years) compared to No-Action Scenario 1. Under No-Action Scenario 2, there would be about 3,300 latent cancer fatalities over 10,000 years as storage facilities across the United States degraded and radionuclides from spent nuclear fuel and high-level radioactive waste reached and contaminated the environment. There would be no fatalities associated with transportation, construction, or operation because those activities would not occur after the presumed loss of institutional control.

S.12.3 AREAS OF CONTROVERSY

The Department acknowledges that areas of controversy exist regarding the Proposed Action and the analyses in this EIS. Areas of controversy were identified during the public interaction processes. Many of these are not resolvable because they reflect either differing points of view or irreducible uncertainties in predicting the future. However, the Department has considered these areas in the development of this Final EIS. Other issues raised by the public are summarized in Section S.4.2.4.

Native American Viewpoint

Disagreement exists about the nature of the repository as it might impact elements of the natural and cultural environment that are of concern to Native American tribes.

Perceived Risk and Stigma

Disagreement exists concerning whether the perception of risk and stigma cause behavioral changes, the ability of researchers to predict future human behavior based on perception of risk and stigma, and the capability to reliably predict economic effects of any such stigma.

High-Level Radioactive Waste—Equivalency of Metric Tons of Heavy Metal

Disagreement exists about the method for calculating the amount of MTHM in a canister of high-level radioactive waste. This would affect the number of canisters that could be disposed of under the Proposed Action.

Engineered Barriers

Disagreement exists about how much reliance should be placed on engineered barriers versus natural barriers to achieve waste isolation in a geologic repository.

Transportation

Disagreement exists regarding factors relevant to the analyses of the potential environmental impacts from the transportation of spent nuclear fuel and high-level radioactive waste including for example, the need for community- and highway-specific information, and assumptions and input information used in the analyses.

Evaluation of Long-Term Performance

Disagreement exists regarding the ability to predict long-term performance for 10,000 years or more. Uncertainties associated with complex natural systems and engineered barrier behaviors and the use of computer models that are unable to rely on the results of long-term testing raise questions about the ability of the Department to predict repository performance.

S.12.4 ISSUES TO BE RESOLVED

There are no issues that remain to be resolved for this Final EIS to accompany any site recommendation.

However, prior to initiation of the Proposed Action to construct, operate and monitor, and eventually close a repository at Yucca Mountain, three primary issues would require resolution:

1. The Yucca Mountain site must be designated under the NWPA for development of a geologic repository.
2. If the site was designated, the Department would have to complete selection of the design features required to support a Licence Application to the Nuclear Regulatory Commission.
3. If the site was designated, the Department would have to make transportation-related decisions required to support implementation of the Proposed Action. Such decisions would include the choice of a national mode of transportation outside of Nevada (mostly legal-weight truck or mostly rail), the choice among alternative transportation modes in Nevada (mostly rail, mostly legal-weight truck, or heavy-haul truck with use of an associated intermodal transfer station), and the choice among alternative rail corridors or heavy-haul truck routes with use of an intermodal transfer station in Nevada.